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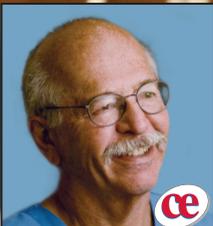
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INTRODUCTION

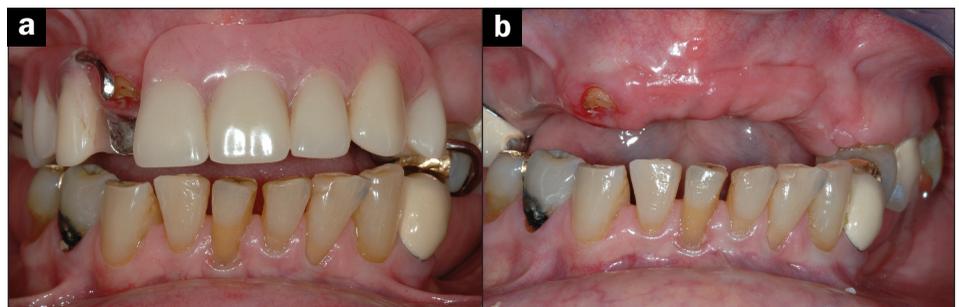
Small-diameter implants (SDIs) are effective in stabilizing removable partial dentures (RPDs)¹ and function to provide a stable “seat” to minimize vertical movement. The natural teeth restrict lateral movements with RPDs, so mini implants are not necessary for this role. SDIs allow the utilization of RPDs even in cases with many missing teeth. Because of lateral movement restriction by the patient’s natural teeth, fewer SDIs are required for use with RPDs than with full-denture stabilization. SDIs also allow the elimination of clasps in many RPD cases.

Most patients would prefer fixed rather than removable dental restorations. With the quality and predictability of today’s root-form implants, fixed bridges, sinus lifts, ridge augmentation through bone grafting, and all-on-4 hybrid/implant restorations, cost is the principal reason that removable final restorations still exist, unless the patient has restrictive health issues.

Background

Root form and SDIs have greatly improved the stability and comfort of removable restorations.¹ It could be argued that state-of-the-art treatment for lower dentures today includes some type of implant stabilization. The use of SDIs for RPD stabilization is sometimes overlooked. Primary objections to RPDs include:

- Since an RPD is removable, when the appliance is out of the mouth, an edentulous area is visible; the removable nature of these prostheses make patients



Figures 1a and 1b. Preoperative photo showing the fractured right cuspid and the existing removable partial dentures (RPDs).



Figures 1c and 1d. Remaining teeth restored, 5 small-diameter implants (SDIs) (3M ESPE) placed.



Figures 1e and 1f. SDI-supported final RPD.

acutely aware that they are missing teeth.

- Visible clasps, especially metal clasps. Modern thermoplastic nylon (flexi)



Figures 2a and 2b. Preoperative photo of the edentulous maxilla and partially edentulous mandible.

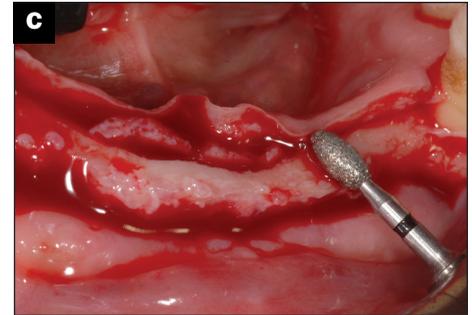


Figure 2c. Recontouring knife-edge mandibular ridge for SDI reception.

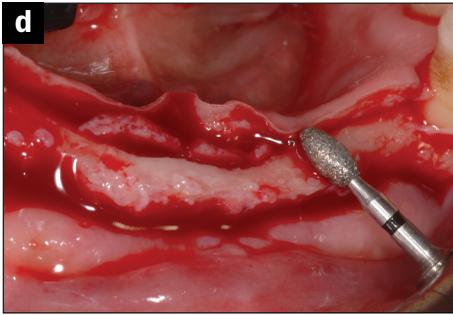
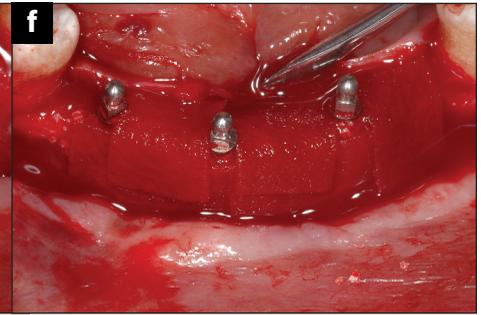
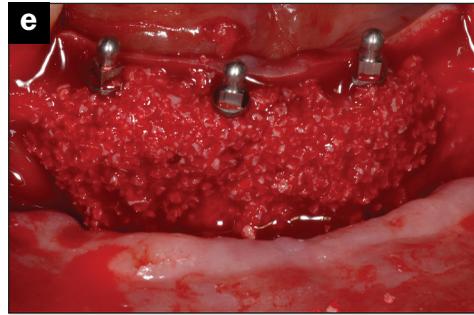


Figure 2d. Recontouring knife-edge mandibular ridge for SDI reception.



Figures 2e and 2f. Bone grafting with resorbable membrane.



Figure 2g. Postoperative mandibular ridge with SDIs.



Figures 2h and 2i. Postoperative maxillary SDI-supported full denture and mandibular SDI-supported RPD.

partials provide tooth- or gingiva-colored clasps, but many patients still dislike the bulky feeling of clasps on the teeth.

- Vertical movement of the partial denture when the patient is chewing.
- Food accumulation around the RPD.

SDIs can improve or eliminate 3 of these objections. They provide excellent vertical stability, eliminating most up-and-down movements of the RPD when the patient is chewing. Since SDIs act like “snaps” on a shirt (only much stronger), there is minimal vertical movement of the RPD when chewing. As with full dentures, RPDs should be supported apically by the ridge and soft tissue, not the SDIs, when the patient bites down. SDIs limit the amount of “rebound” coronal movement of the RPD. The o-rings in the hous-

ings cushion the biting and rebound movement of the RPD, much like periodontal ligaments around teeth.

Clasps are often not necessary when SDIs are utilized to stabilize RPDs, especially if the patient is not eating sticky foods. Without clasps, less food accumulates around the RPD. The o-rings (Evolution Dental Science) in the housings or the type of housing itself (MH-1, 2, or 3 [3M ESPE]) can be changed to increase retention. A chief “tongue-in-cheek” complaint of patients with SDI-stabilized dentures and RPDs is that they have a hard time removing the appliance. The author has only once been asked to increase retention with a full denture, and never with an RPD.

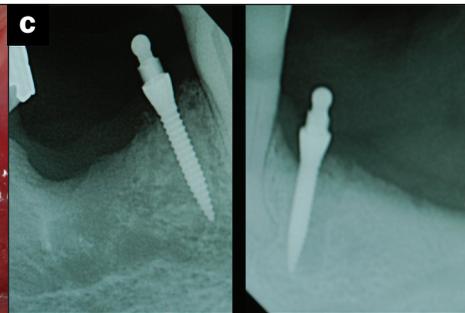
RPD stabilization is not the same as full-denture stabilization. With full den-

tures, SDIs prevent lateral movement and upward displacement, and provide a stable seat when the patient is biting. As previously stated, the primary role of SDIs used with RPDs is to provide a stable seat to minimize vertical movement. The rule of thumb with full dentures is that 2 SDIs take the place of one root-form implant.² With RPDs, one SDI generally replaces one root-form implant, since the natural teeth prevent lateral movement of the RPD.

Lateral forces necessitate the 2:1 SDI to root-form implant ratio with full dentures because a certain implant surface area is needed to prevent implant displacement due to lateral forces. The necessary implant surface area is not specific, but varies depending on the lateral force the patient places on the implants, espe-



Figure 3a. Edentulous posterior mandible.



Figures 3b and 3c. SDIs placed in lower left cuspid and lower right first bicuspid sites.

cially from clenching/bruxism. Chronic lateral forces, usually from clenching and bruxism, are the “implant enemy.”

It is known that health issues, such as smoking and diabetes, contribute to implant failure due to compromised bone quality as well as reduced blood flow/oxygenation of the bone.^{3,4} However, it is the author’s opinion that repetitive lateral forces from clenching and bruxism, especially during the first few months following implant placement, are a primary cause of implant failure. This is especially true if there is minimal bone on the facial side of the implant. Overall surface area of the combined implants as well as bone type versus duration and intensity of lateral forces is an important consideration prior to implant placement. If the patient was a major bruxer/clencher prior to tooth loss, that habit is a big warning sign. Unless the habit has ceased, the patient should be prepared for potential implant loss from excessive, repetitive lateral forces.⁵ In these situations, both root-form implants and SDIs can be displaced. The length and width of the implants, plus the greater the number of implants (greater surface area), in addition to delayed loading and allowing complete implant osseointegration prior to loading, are important factors for implant longevity.¹

Additionally, if patients with bruxism can either sleep without their full or partial denture, or wear a flat-plane hard acrylic nightguard over the implant-supported appliance, the lateral displacing forces on the implants will be minimized. As previously stated, lateral forces are not nearly as detrimental to implants with RPDs as they are to full dentures, due to the patient’s natural teeth absorbing most of that lateral force.

It is reasonable to question: “Why SDIs for full- or partial-denture stabilization? Why not use root-form implants



Figures 3d and 3e. Picking up housings in existing RPD with hard (fast-set) pick-up acrylic.



Figures 3f and 3g. Presenting RPD stabilized with SDIs.

with locators exclusively?” The author utilizes both root-form implants and SDIs in his restorative practice. The advantages of SDIs over root-form implants in specific situations are as follows:

- Less lingual-facial bone width is required. SDIs can be placed with as little as 4.0 mm of lingual-facial bone width.^{2,6}

- With the exception of severely atrophied mandibular ridges exhibiting D1-type bone, ie, primarily cortical bone with minimum trabecular bone, only the cortical plate is pierced with the pilot drill. The SDI then very slowly “bites” its way through the trabecular bone to depth. With root-form implants, the osteotomy must be drilled into the bone to the full length of the implant. This difference might be important in the area of the mental foramen/inferior alveolar nerve. If one needed to operate in this

area, any nerve or vessel encountered by mistake would be “displaced,” not severed, with SDI placement. This situation should not occur, especially with cone beam radiography, when indicated. Nonetheless, it provides the operator peace of mind, knowing that a mistakenly encountered nerve or vessel would be displaced rather than severed with SDI placement.

- Studies show the long-term prognosis of appropriately placed SDIs is the same as root-form implants.¹

- If an SDI is lost, it is easily replaced, and the full or partial denture can be easily repaired to accept a new SDI; normally, in one short appointment. A small percentage of root-form or mini implants will be lost, so replacement/ability to repair is a consideration.

- Restorative/general dentists, who might not otherwise be comfortable

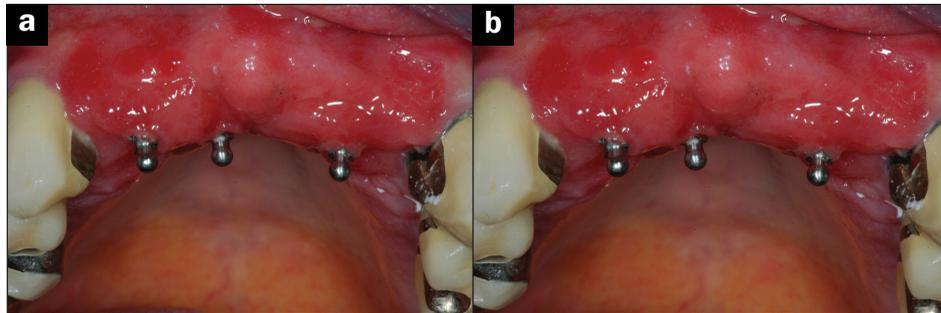
placing root-form implants, should be comfortable and competent placing SDIs after taking appropriate training.

Several SDI-retained RPD mini case reports will now be presented.

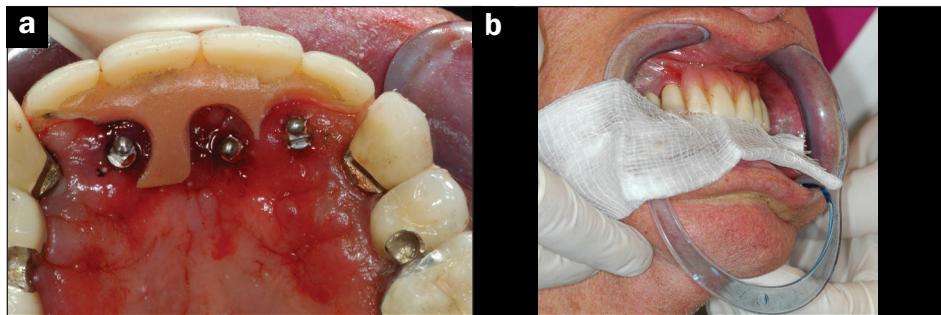
CASE REPORTS

Case 1

A 65-year-old nurse presented with a long-standing maxillary RPD (Figures 1a and 1b). The maxillary right cuspid had fractured off at the gumline, leaving a wide anterior edentulous space. The edentulous space was too large for a conventional nonimplant-supported RPD. Following appropriate restoration of the remaining teeth and deficient vertical dimension of occlusion increase, an SDI-supported maxillary RPD was fabricated. Five 2.9- x 13-mm SDIs (3M ESPE) were placed in the maxillary anterior edentulous area. MH-1 housings were utilized (Figures 1c to 1f).



Figures 4a and 4b. Three SDIs placed to stabilize broken maxillary RPD.



Figures 4c and 4d. Picking up housings in existing RPD with hard (fast-set) pick-up acrylic (Secure [3M ESPE]).



Figures 4e to 4g. Presenting broken RPD secured with SDIs.

Case 2

A 60-year-old retired teacher presented with a loose and unaesthetic mandibular RPD and maxillary full denture (Figure 2). Five 2.4- x 13-mm SDIs (3M ESPE) were placed to secure a new maxillary full denture, and three 1.8- x 13-mm SDIs were placed in the mandibular anterior edentulous region to secure a new mandibular RPD. The mandibular anterior edentulous ridge was inadequate lingual-facially as well as knife-edged. It was surgically modified and bone grafted to receive the SDIs.

Case 3

An 80-year-old female presented with a hopelessly fractured lower left cuspid (Figure 3). A mandibular RPD with left distal extension and clasp on that lower left

cuspid had been in place for many years. Restorative cost was a major factor for this patient.

Following extraction of the hopeless cuspid, a wrought wire clasp was added to the partial denture on the facial of the lower left central and lateral incisors in a failed attempt at stabilization.

Six months post-extraction, 1.8- x 10-mm SDIs were placed in the healed extraction site of the lower left cuspid as well as the lower right first bicuspid edentulous area and retrofitted to the existing RPD. Both ridges were narrow and measured approximately 12 mm from the alveolar crests to the inferior alveolar nerves. Although the inferior alveolar nerves and mental foramina were not major concerns in this case, one must always take these into clinical consideration. Ideally, implants would be

placed at least 7.0 mm mesial to the mental foramen and 2.0 mm superior to the inferior alveolar nerve.^{7,8} If this is not possible, the apical tip of the SDI should be angled slightly to the lingual since the inferior alveolar nerve is toward the facial aspect of the inferior border of the mandible and, obviously, exits the mandible on the facial. The operator must be especially careful in the mental foramen area when the mandible is severely atrophied. In the atrophied mandible, the mental foramen will be near or at the level of the alveolar crest.

Case 4

An 83-year-old male presented with a broken anterior RPD replacing his 4 maxillary incisor teeth (Figure 4). He reported that the broken partial had never been very stable. Following an

appropriate clinical and radiographic examination, it was determined the existing RPD could be modified and salvaged using SDIs.

The presenting metal attachments were removed from the mesial of the cuspid crowns and three 2.4- x 13-mm SDIs were placed in that 4-tooth edentulous segment. Care was taken to avoid the incisive foramen, and to leave 5.0 mm between the SDIs as well as the cuspid teeth. The attachments were removed from the broken RPD. Next, holes were cut in the acrylic to accommodate the housings placed on the SDIs. Fast-set pick-up acrylic (Secure [3M ESPE]) was placed in the holes previously cut in the acrylic. The partial was then seated on the housings snapped on the SDIs. One thickness of 2-x-2 gauze covered the palatal of the RPD to contain the flowable pick-up acrylic and to prevent it from adhering to the opposing teeth. The patient was instructed to bite down on the RPD covered with the 2-x-2 gauze while the acrylic cured to ensure correct occlusion on the unstable prosthesis. The excess

pick-up acrylic was trimmed and polished and the occlusion adjusted slightly.

Six months later, the patient reported that the RPD was extremely secure and that function with the prosthesis was excellent.

IN SUMMARY

SDIs are an excellent restorative choice for full- and partial-denture stabilization. They are also effective in some fixed restorative situations.

As described in this article, SDIs:

- Allow RPD utilization when many teeth are missing.
- Minimize vertical movement of RPDs when the patient is chewing.
- Minimize, or eliminate, the need for RPD clasps.
- Can be placed in edentulous areas with as little as 4 mm of facial-lingual bone width.^{2,6}
- Normally require only pilot drill penetration of the cortical plate. The SDI then slowly “bites” its way to depth, much like a wood screw, virtually eliminating the possibility of nerve or vessel damage.

- Are as durable as root-form implants if treatment planned and placed appropriately.¹

- Are easily replaced if occasionally lost. The removable partial, or full denture, is then easily repaired to receive a new housing for the SDI replacement.

- Are a restorative option most GPs, with training, should be comfortable utilizing in their own practices.♦

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Dr. Cutbirth practices restorative dentistry in Waco, Texas (wacosedationdentist.com), and is director of the Center for Aesthetic Restorative Dentistry (CARD) (centerforard.com), located in Dallas, a hands-on, complex restorative teaching center for practicing dentists. He graduated from Baylor Dental College in 1979, then completed a 2-year fellowship at Baylor, then was a member of the teaching faculty at the Pankey Institute in Florida for 20 years. He has lectured and published extensively on the topics of systematic restoration of the severely worn dentition with vertical dimension increase, diagnosis and treatment of occlusal problems and facial pain, complex aesthetic restorative dentistry, ridge modification and bone grafting for small-diameter implant utilization, and the most effective/productive dental practice system. He can be reached at (254) 772-5420 or via e-mail at card1611@gmail.com.

Disclosure: Dr. Cutbirth is an occasional lecturer for 3M ESPE but has received no compensation for writing this article.